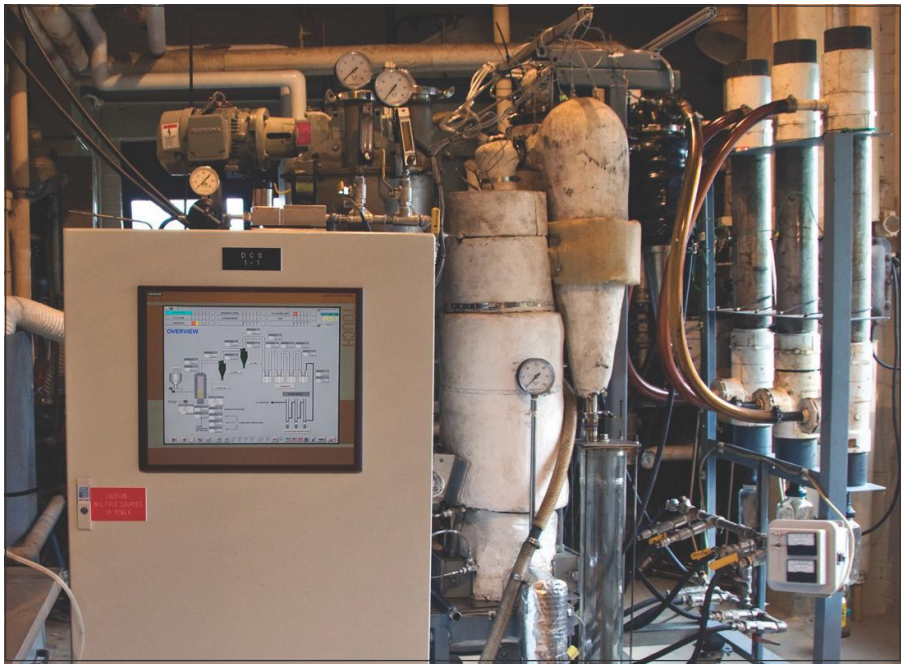
Fast Pyrolysis

ARS Researchers Team Up With Siemens to Make Bio-Based Oil



The fast pyrolysis reactor used by research scientists at the Agricultural Research Service Eastern Regional Research Center in Wyndmoor, PA, has a Siemens PCS7 control system, on the left of the reactor, to control pressures, temperatures, biomass weight, feed speed and the pyrolysis reaction.

Research scientists led Dr. Akwasi Boateng at the Agricultural Research Service (ARS) Eastern Regional Research Center (215-233-6493) in Wyndmoor, PA, are producing a renewable bio-oil using an innovative fast pyrolysis method that heats biomass feedstocks in the absence of oxygen.

The bio-oil being produced at the Wyndmoor research center in suburban Philadelphia can be refined into a bio-based gas or diesel that can be used as a drop-in replacement for petroleum-based gas or diesel.

A Siemens PCS7 control system is being utilized in the research, through a two-year agreement with Siemens Industry, Inc. of Spring House, PA.

Neil Goldberg, supervisory mechanical engineer at ARS, said fast pyrolysis of biomass sources like crop residues, switchgrass, and even chicken litter can be turned into bio-oil.

Biomass Vaporizes

"We very quickly heat the biomass in a fluidized bed reactor in the absence of oxygen so it doesn't burn. It vaporizes," said Charles Mullen, ARS research associate chemist. "Then, we take the vapors and condense them into bio-oil."

Bio-oil contains about 20-30 megajoules per kilogram, which is a standard measurement of energy, Goldberg said. Petroleum diesel has about 40

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megajoules per kilogram.

Bio-oil's co-product, called bio-char, can be used for fertilizer and as a way to sequester carbon in the soil, Mullen said.

750 Degrees F

Modern fast pyrolyzers are designed to produce bio-oil by heating biomass to more than 400 degrees C or about 750 degrees F in less than one second in the absence of oxygen, Goldberg said.

"One of the best things about this process is that it's not feedstock-specific," said Goldberg. "Just about any biomass feedstock can be used in the fast pyrolysis process to make bio-oil. There's no change in the process, but the end product is determined by the feedstock."

Looking for Partners

Kevin Hicks, research leader at the Eastern Regional Research Center, said that although the fast pyrolysis project is still in the research stage, ARS is looking for commercial partners.

"Our research is aimed at perfecting the process so it can be commercialized," Hicks said.

The ARS has a two-year agreement with Siemens to use its PCS7 distributive controller , Goldberg said, along with the hardware and engineering support for the ARS pyrolysis reactor.

"Siemens has been involved deeply in the commercialization of biofuels and believes pyrolysis may be the next step," Goldberg said.

The current two-year agreement with Siemens runs through next year.

Pyrolysis Reaction

Rich Chmielewski, chemical and biofuels marketing manager at Siemens Industry, Inc. (215-646-7400, ext. 2491), said the PCS7 controls pressures, temperatures, biomass weight, feed speed, and the pyrolysis reaction.

"The PCS7 allows a fine-tuning of the process," he said. "This is a pathway to producing renewable fuels and it gives us credibility in the industry to participate in an experiment with the USDA."

Siemens has more than $50,000 invested in the project, Chmielewski said.

Fast pyrolysis can solve one of the problems facing biomass as a renewable fuel feedstock, Chmielewski said, and that is how to move large amounts of the material.

Biofuels Near the Source

"This will allow us to produce bio-oils near the source and move the bio-oil to a biorefinery," he said. "The other benefit is that you can use this technology to make bio-oil more flexibly. It doesn't need chemicals or enzymes that have to be specific to a certain type of biomass."

Hicks said that one of the major goals of the research is to be able to understand conditions in the reactor that produce the best quality bio-oil and bio-char.

Fine Tune Conditions

"Using a distributive control system like the Siemens PCS7 can help us fine-tune those conditions and have a record of those conditions," he said.

Goldberg said the pyrolysis reactor currently being used is running about five kilograms of biomass an hour.

"We have plans to move up to one ton a day," he said. "One of the things we like about the smaller size reactor is that we can screen lots and lots of feedstocks. The non-specificity of the feedstocks is very exciting."

Jerry Perkins, editor

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